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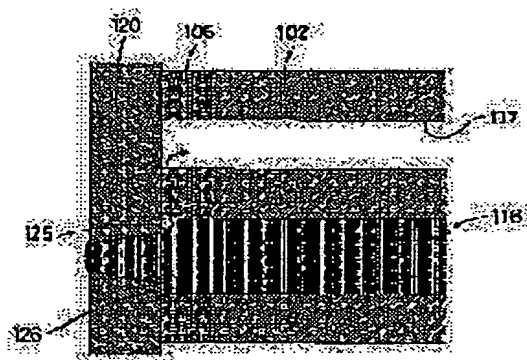
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(54) INK JET APPARATUS

(57)Abstract:

PROBLEM TO BE SOLVED: To prevent the bending flight or non-injection or an ink jet liquid droplet caused by the mixing with air bubbles.

SOLUTION: An air passing member 106 permitting air to pass but not ink to pass is held between a nozzle plate 120 and a cover plate 102 in order to remove air bubbles in an ink liquid chamber 116 and the non-jet chamber 117 adjacent to the ink liquid chamber 116 is always held to low pressure. By this constitution, air bubbles 125 in the ink liquid chamber 116 can be taken in the non-jet chamber 117 without drawing in ink.



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CLAIMS

[Claim(s)]

[Claim 1] The nozzle which injects ink, and the liquid ink room where it filled up with ink while it was open for free passage for said nozzle, In the ink fuel injection equipment which has the septum which separates the non-injecting room which is adjoined and established in said liquid ink room, and does not inject ink, and said liquid ink room and a non-injecting room, and an energy generation member for adding an injection pressure to said liquid ink room It is the ink fuel injection equipment characterized by making the air bubbles which said some of septa [at least] were equipped with the suction device which consists of a porous member to which through ink does not let air pass, and controls the air pressure of the interior of a room non-injecting [said], and it mixed in said liquid ink interior of a room shift to a non-injecting liquid room through said porous member.

[Claim 2] The path of the hole formed in said porous member is an ink fuel injection equipment according to claim 1 characterized by being 0.5 micrometers or less.

[Claim 3] Said porous member is an ink fuel injection equipment according to claim 1 or 2 characterized by having ** ink nature.

[Claim 4] The ink fuel injection equipment according to claim 1 to 3 characterized by the section near the nozzle of said septum consisting of said porous member.

[Claim 5] Said porous member is an ink fuel injection equipment according to claim 1 to 4 characterized by consisting of fluororesin.

[Claim 6] Said porous member is an ink fuel injection equipment according to claim 1 to 4 characterized by consisting of urethane system resin.

[Claim 7] The air pressure of the interior of a room non-injecting [said] is an ink fuel injection equipment according to claim 1 to 6 characterized by being kept at 0.5 or more-atm less than 1 atm according to said suction device.

[Claim 8] Said septum is an ink fuel injection equipment according to claim 1 to 7 characterized by serving as an energy generation member.

[Claim 9] polarization of the septum which is said energy generation member is carried out in the standing-up direction — having — **** — and said direction of polarization and abbreviation — the ink fuel injection equipment according to claim 8 characterized by preparing the electrode which impresses perpendicular drive electric field in a both-sides side, fluctuating the pressure of the liquid ink interior of a room by impression of drive electric field, and making a liquid ink drop inject.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]**[0001]**

[Industrial Application] This invention relates to the ink fuel injection equipment which has the device in which detailed liquid ink indoor air is removed about the ink fuel injection equipment which a liquid ink drop is made to fly and forms the alphabetic character or graphic form by the dot on a printing medium.

[0002]

[Description of the Prior Art] In recent years, it changes for the recording device of an old impact method, and the recording device of an ink jet method is mentioned most simply [a principle] as what has the easy formation of many gradation and colorization in the recording device of the non impact method to which the commercial scene is expanded greatly. Ink is made to inject from the nozzle hole of the head section, when an ink jet type recording device gives a pressure to ink, printing etc. is performed, and since there is an advantage, like a manufacturing cost can make possible low high-speed printing, the low noise, a high quality of printed character, and a miniaturization with a comparatively simple configuration, development various in recent years is progressing.

[0003] Two or more methods are proposed by the print head used for an ink jet type recording device, and the drop mold on demand which injects only the ink droplet used for record especially has spread quickly from the goodness of injection effectiveness, the low price of a running cost, etc.

[0004] There is a method of using a piezoelectric device for one of them as an energy generation component for ink injection. The head part For example, the nozzle plate 220 in which the nozzle 221 by which ink is injected was formed as shown in drawing 7 , It has the liquid ink room 216 which leads ink to said nozzle plate 220, and the non-injecting room 217 contiguous to said liquid ink room 216. The septum which separates said liquid ink room 216 and said non-injecting room 217 is formed of the member of the manifold 230 grade which leads the actuator 201 currently formed by electrostrictive ceramics, and the ink from the ink tank which is not illustrated to said liquid ink room 216.

[0005] The electrode is formed in the front face of the septum which consisted of electrostrictive ceramics, as for said electrode, the electric wiring of a driver is connected by wirebonding etc., and driver voltage is supplied through this electric wiring. By displacing by impression of said driver voltage, changing the volume of the liquid ink room 216, and making a pressure add to the ink in the liquid ink room 216, a liquid ink drop is made to breathe out from a nozzle 221, and the septum is printing it.

[0006]

[Problem(s) to be Solved by the Invention] However, especially as for an ink jet type recording device, air may invade in the liquid ink room 216 from a nozzle 221 side in the case of a drive. As shown in drawing 7 , in case the air bubbles 225 which invaded join said nozzle plate 220 and actuator 201, a location like the level difference 226 formed between the liquid ink rooms 216 tends to be covered with them the ink inflow side of a nozzle plate 220. If air bubbles 225 are small, the effect affect injection will also be small and there will be no big

problem, but if air bubbles 225 coalesce, it grows up and a diameter becomes large with about 40 micrometers, it will come to do various bad influences. For example, the flow of ink is disturbed and the problem that will not start injection deflection or ink will not be injected by absorption of the ink injection energy by air bubbles 225 arises.

[0007] Therefore, when the above-mentioned fault occurred, recovery action which removes the air which remains in the liquid ink room 216 periodically had to be performed. For that purpose, the conventional ink jet type recording device had to possess complicated maintenance equipments, such as a sensor which detects that poor printing occurred, and a purging machine style which discharges the ink in the liquid ink room 216 compulsorily. Moreover, printing was frequently interrupted by said recovery action and there was fault that processing speed fell.

[0008] This invention is made in order to solve the trouble mentioned above, it removes efficiently the air bubbles of the liquid ink interior of a room, without interrupting printing actuation for a simple device, and aims at offering the reliable ink fuel injection equipment with a good record precision which faults, such as the injection deflection of a liquid ink drop and un-injecting, do not produce.

[0009]

[Means for Solving the Problem] In order to attain this purpose the ink fuel injection equipment of this invention The nozzle which injects ink, and the liquid ink room where it filled up with ink while it was open for free passage for said nozzle, The non-injecting room which is adjoined and established in said liquid ink room, and does not inject ink, It is what has the septum which separates said liquid ink room and a non-injecting room, and an energy generation member for adding an injection pressure to said liquid ink room. Furthermore, said some of septa [at least] are equipped with the suction device which consists of a porous member to which through ink does not let air pass, and controls the air pressure of the interior of a room non-injecting [said], and it makes the air bubbles mixed in said liquid ink interior of a room shift to a non-injecting liquid room through said porous member.

[0010] In addition, the path of the hole formed in said porous member may be 0.5 micrometers or less.

[0011] In addition, said porous member may have ** ink nature.

[0012] In addition, the section near the nozzle of said septum may consist of said porous member.

[0013] In addition, said porous member may consist of fluororesin.

[0014] In addition, said porous member may consist of urethane system resin.

[0015] In addition, the air pressure of the interior of a room non-injecting [said] may be kept at 0.5 or more-atm less than 1 atm by said suction device.

[0016] In addition, said septum may serve as an energy generation member.

[0017] in addition, polarization of the septum which is said energy generation member is carried out in the standing-up direction — having — **** — and said direction of polarization and abbreviation — the electrode which impresses perpendicular drive electric field is prepared in a both-sides side, the pressure of the liquid ink interior of a room is fluctuated by impression of drive electric field, and a liquid ink drop may be made to inject [0018]

[Function] The pressure of the liquid ink interior of a room is changed by the energy generation member, and a liquid ink drop is made to inject from a nozzle in the ink fuel injection equipment of this invention which has the above-mentioned configuration according to claim 1. Moreover, since the adjoining liquid ink room is isolated by the non-injecting liquid room, the cross talk is reduced.

[0019] Moreover, the air bubbles mixed in the liquid ink interior of a room are made to draw in said non-injecting interior of a room from some septa which consist of a porous member by adjusting the air pressure of the non-injecting interior of a room according to a suction device. In addition, since the porous member is constituted so that through ink may not let air pass, there is no possibility of incorporating ink with air bubbles in a non-ink room. Therefore, the air bubbles which have a bad influence on ink injection can be removed continuously, time

amount for condition recovery cannot be used, but the aggravation of impact precision and the condition of not injecting by air bubbles can be avoided.

[0020] In an ink fuel injection equipment according to claim 2, many fine holes 0.5 micrometers or less are formed in the porous member for the path, and it prevents that ink penetrates a porous member.

[0021] In an ink fuel injection equipment according to claim 3, since a porous member has ** ink nature, a possibility that ink may penetrate a porous member is reduced extremely.

[0022] In an ink fuel injection equipment according to claim 4, since a porous member is formed near [in which air bubbles tend to pile up] the level difference section made to the joint of a septum and a nozzle, air bubbles are efficiently removable exactly.

[0023] In an ink fuel injection equipment according to claim 5, since a porous member consists of fluororesin, it becomes possible to be able to give ** ink nature to a porous member, without performing special processing processing, and to manufacture easily what has high endurance.

[0024] In an ink fuel injection equipment according to claim 6, since a porous member consists of urethane system resin, it makes it possible to manufacture comparatively easily the porous member which has a finer aperture.

[0025] In an ink fuel injection equipment according to claim 7, air bubbles become are easy to be incorporated with said negative pressure at a non-injecting room certainly, without drawing with ink, since the air pressure of the non-injecting interior of a room is kept at 0.5 or more-atm less than 1 atm by the suction device.

[0026] In an ink fuel injection equipment according to claim 8, a septum has the configuration which served as the energy generation component, and a small fuel injection equipment with few configuration members can be offered.

[0027] In an ink fuel injection equipment according to claim 9, the septum which constitutes a liquid ink room shear-strains by impression of drive electric field, and injects a liquid ink drop from a nozzle using the pressure fluctuation resulting from fluctuation of the liquid ink room volume accompanying it.

[0028]

[Example] Hereafter, one example which materialized this invention is explained with reference to a drawing.

[0029] First, the process and structure of an ink fuel injection equipment of this example are explained. As shown in drawing 1, the side attachment wall 111 which separates two or more slots 115 and its slot 115 on one side of the electrostrictive ceramics plate 105 of the PZT system (titanic-acid lead zirconate) which performed polarization processing is formed in the direction of an arrow head 104. The metal electrode 113 for driver voltage impression is formed in the both-sides side of a side attachment wall 111 by metal vacuum evaporation, a spatter, electroless deposition, etc.

[0030] On the other hand, the aeration member 106 (drawing 5) which consists air of a porous member which does not let through ink pass has pasted up the cover plate 102 which consists of an alumina etc. on the end face of said cover plate 102. and a well-known slot end processing technique shows to drawing 1 — as — the aeration member 106 — it is together formed in the configuration which has two or more side attachment walls 108 and slots 109.

[0031] And the side attachment wall 108 of this cover plate 102 and the side attachment wall 111 of the electrostrictive ceramics plate 105 are joined through the junctional zone 103 which consists of epoxy system adhesives etc. Then, as shown in drawing 2, the ink fuel injection equipment 101 equipped with two or more channels 112 which were separated by the septum 110 and said septum 110, and were arranged in the longitudinal direction of space is formed.

[0032] the configuration where a channel 112 is long and slender in the perpendicular direction of the space of the rectangular section — it is — a side attachment wall 111 — a channel 112 — it is mostly extended covering the overall length. Moreover, the nozzle plate 120 (drawing 4) in which the nozzle hole 121 (drawing 4) for carrying out the regurgitation

of the ink droplet opened pastes the edge of a direction perpendicular to the space of drawing 2 , and the other end is equipped with the manifold (not shown) for supplying ink. The nozzle hole 120 is alternately open for free passage with a channel 112, and only the nozzle hole 120 and the channel 112 open for free passage are filled up with ink from a manifold. The channel 112 with which the channel 112 with which this ink was filled up adjoins the liquid ink room 116 (drawing 5) at this liquid ink room 116, and ink is not filled up serves as the non-injecting room 117 (drawing 5).

[0033] On the other hand, the porous member used as an ingredient of the aeration member 106 presents ** ink nature and ink-proof nature, and, as for air, that in which many holes of extent which does not let through ink pass were formed is used. Specifically, that by which the aperture is formed in 0.5 micrometers or less to common ink jet type ink is good. As a concrete ingredient, the good ingredient of workability or handling nature is suitable, and fluororesin, urethane system resin, high density nylon, etc. are used especially more preferably. Especially fluororesin has ink-proof nature and high workability while not processing it and also equipping ** with high ** ink nature. On the other hand, foaming processing is easy for urethane system resin, and it is suitable to form the porous member which has a finer aperture.

[0034] In addition, the porous member could make the thing in which what mixed not only a thing but two or more ingredients which consist of an ingredient simple substance which was mentioned above, and the thing which carried out the laminating of two or more porous sheets also made the above-mentioned porous member contain an ultrafine particle, and the porous member contain ** ink nature material.

[0035] Furthermore, the manifold side edge section of all the non-injecting rooms 117 is opened for free passage with the suction device which consists of a suction pump etc. and which is not illustrated, and the air pressure of the non-injecting room 117 is maintained at always suitable low voltage by this suction device. It is kept concrete so that it may become the pressure of the 0.5 or more atms range of less than 1 atm. It is made to make the air bubbles mixed in the liquid ink room 116 draw into said non-injecting room 117 with this negative pressure from some septa 108 which consist of a porous member. In addition, if the air pressure of said non-injecting room 117 becomes smaller than 0.5atm(s), since possibility of incorporating ink will become high, it is not desirable.

[0036] As for the air pressure of the above-mentioned non-injecting room 117, and the special feature of a porous member, it is desirable that the value doubled with the properties (viscosity, surface tension, the class of color material, etc.) of the ink used for the ink fuel injection equipment 101 is chosen. Moreover, the air pressure of the non-injecting room 117 and the path of the hole prepared in a porous member have a correlation, when the air pressure of a non-injecting room is comparatively high, said aperture is large, and when said air pressure is comparatively low, said aperture is set up small. Among those, it is large in the aperture of a porous member as much as possible, and if the air pressure of a non-injecting room is set up highly, while manufacture of a porous member becomes easy, correspondence will become possible by the simple suction device. Moreover, the effectiveness of incorporation of air bubbles also becomes high.

[0037] Next, drawing 2 and drawing 3 explain actuation of the ink fuel injection equipment 101. In the ink fuel injection equipment 101, if liquid ink room 116a is chosen according to the given printing data, 113d of metal electrodes and forward driver voltage will be impressed to 113g, and the metal electrode corresponding to the liquid ink room 116 and the non-injecting room 117 of metal electrodes 113e and 113f and others will be grounded. Thereby, in side-attachment-wall 111b, the drive electric field of the direction of arrow-head 114b occur, and the drive electric field of the direction of arrow-head 114c occur in side-attachment-wall 111c. Since the directions 114b and 114c of drive electric field and the direction 104 of polarization of the electrostrictive ceramics plate 105 lie at right angles at this time, side attachment walls 111b and 111c deform in the direction of the interior of liquid ink room 116a quickly according to the piezo-electric thickness skid effectiveness.

[0038] Since it is joined by the junctional zone 103, the side attachment walls 108b and 108c

by the side of a cover plate 102 follow in footsteps of side attachment walls 111b and 111c, and deform toward the interior of liquid ink room 116a. The volume of liquid ink room 116a decreases according to these deformation, the ink pressure of ink room 116a increases quickly, a pressure wave occurs, and a liquid ink drop is injected from the nozzle 121 which is open for free passage to ink room 116a.

[0039] Moreover, if impression of driver voltage is stopped, since side attachment walls 111b and 111c will follow in footsteps of the location before deformation (refer to drawing 2) at return and it and side attachment walls 108b and 108c will also return to the location before deformation (refer to drawing 2), ink is supplied in ink room 116a through the manifold which the ink pressure in ink room 116a declines, and is not illustrated from the ink feed hopper which is not illustrated.

[0040] However, when it does not pass over the above-mentioned actuation in basic actuation but shape is taken as a product, it impresses in the direction in which the volume increases driver voltage first, after making ink supply to ink room 116a previously, impression of driver voltage is stopped, side-attachment-wall 111b, and 111c, 108b and 108c are returned to the location before deformation (refer to drawing 2), and a liquid ink drop may be made to inject. In order to attenuate the pressure wave of the ink interior of a room after liquid ink drop injection furthermore, the driver voltage pattern called a cancellation pulse may be made to accompany after appropriate time amount.

[0041] When air invades from a nozzle 121 like drawing 6 and air bubbles 125 are generated now, air bubbles 125 are ****(ed) into the level difference part 126 by the vibration at the time of printing, buoyancy, etc. thus — if air mixes in the liquid ink room 116 — the former — air — one after another — remaining — growing up — just — being alike — the fault that poor injection arose and a quality of printed character deteriorated had occurred.

[0042] However, the ink fuel injection equipment 101 of this example is constituted by some septa which separate each channel 112, and the aeration member 106 which about 120 nozzle plate specifically becomes from a porous member as shown in drawing 4 thru/or drawing 6 . And since the air pressure in the non-injecting room 117 is always maintained at low voltage by said suction device, the air bubbles 125 in the liquid ink room 116 are lengthened by the negative pressure of said non-injecting room 117, and are incorporated through an aeration member at the low-tension side 117, i.e., a non-injecting room. Therefore, before air bubbles 125 grow so that they affect an injection property, they are removed one after another. In addition, as mentioned above, since the hole with a porous very fine member is formed, there is no possibility that even ink may be incorporated at the non-injecting room 117 at this time.

[0043] it enables it for removal of the air bubbles which have a bad influence on ink injection with the ink jet head of ***** to need neither a complicated 7 recovery device nor the time amount for condition recovery, but to avoid the aggravation of impact precision and the condition of not injecting by air bubbles, since it is continuously possible like [it is ***** from having explained above and].

[0044] In addition, modification various in the range which does not deviate from the meaning of this invention is possible for this invention, without being limited to the above-mentioned example. For example, although the aeration member 106 which becomes about 120 nozzle plate from a porous member was formed in this example, it may be prepared in the pars intermedia of ink passage. However, it is efficient to be prepared near the part in which air bubbles tend to pile up, and it is desirable.

[0045] Moreover, it does not expose outside but the aeration member 106 which consists of a porous member may be formed only in the part of a septum 110.

[0046] Moreover, this invention can be carried out also to the ink fuel injection equipment of various injection methods, without being caught by the drive method of the ink fuel injection equipment described to said example of the account of a fruit.

[0047]

[Effect of the Invention] It enables it for removal of the ***** air bubbles which have a bad influence on ink injection with the ink jet head of this invention like not to use the time

amount for condition recovery, but to avoid continuously, the aggravation of impact precision and the condition of not injecting by air bubbles, from having explained above, since it is possible.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

[Drawing 1] It is the sectional view showing the manufacture approach of the ink fuel injection equipment of one example of this invention.

[Drawing 2] It is the sectional view showing the ink fuel injection equipment of said example.

[Drawing 3] It is the sectional view showing actuation of the ink fuel injection equipment of said example.

[Drawing 4] It is the perspective view showing the ink fuel injection equipment of said example.

[Drawing 5] the ink fuel injection equipment of said example is shown — it is a fracture perspective view a part.

[Drawing 6] It is the sectional view expanded near the nozzle of the ink fuel injection equipment of said example.

[Drawing 7] It is the sectional view having shown the outline of the conventional ink fuel injection equipment.

[Description of Notations]

102 Cover Plate

105 Electrostrictive Ceramics Plate

106 Aeration Member

108 Septum

111 Septum

116 Liquid Ink Room

117 Non-Injecting Room

120 Nozzle Plate

125 Air Bubbles

[Translation done.]